

## Claims

1. A flexible energy absorbing sheet material comprising a resilient carrier with voids or cavities therein, said carrier being coated or impregnated with a dilatent material .  
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2. A sheet material as claimed in claim 1 wherein the dilatant material is a dilatant compound.
- 10 3. A sheet material as claimed in claim 1 or claim 2 wherein the carrier is a spacer material.
4. A sheet material as claimed in claim 1 wherein the resilient carrier is a spacer fabric comprises a resilient core sandwiched between a pair of covering  
15 layers.
5. A sheet material as claimed in claim 4 wherein the resilient core comprises a layer of yarn and the covering layers have a plurality of apertures therein.
- 20 6. A sheet material as claimed in claim 5 wherein the apertures in the covering layers are hexagonal in shape.
7. A sheet material as claimed in claim 5 wherein the apertures in the covering layers are diamond shaped.  
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8. A sheet material as claimed in claim 5 wherein the yarn is woven into a resilient pile.
9. A sheet material as claimed in claim 5 wherein the yarn is knitted into a  
30 resilient pile.

10. A sheet material as claimed in claim 8 or claim 9 wherein the yarn is between 0.05-1mm in diameter.

11. A sheet material as claimed in any of claims 5 to 10 wherein the yarn is a  
5 monofilament.

12. A sheet material as claimed in claim 4 wherein the outer surface of each covering layer is formed with a plurality of compressible bubbles therein.

10 13. A sheet material as claimed in claim 4 wherein elongate hollow channels are formed in the compressible core.

14. A sheet material as claimed in claim 13 wherein the channels are tubular and parallel to each other.

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15. A sheet material as claimed in any preceding claim wherein holes are formed through said sheet.

16. A sheet material as claimed in claim 1 wherein the resilient carrier is made  
20 of a foam material.

17. A sheet material as claimed in claim 16 wherein the carrier is an open cell foam.

25 18. A sheet material as claimed in claim 1 wherein the resilient carrier is a fleece material.

19. A sheet material as claimed in claim 1 wherein the resilient core is a "Scotch-Bright" material (Trade Mark).

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20. A flexible energy absorbing sheet material comprising a resilient core of discrete modules made of dilatent compound sandwiched between a pair of covering layers.

5 21. An energy absorbing sheet as claimed in claim 20 wherein the modules are randomly arranged in the compressible core.

22. An energy absorbing sheet as claimed in claim 20 wherein the modules are arranged in axially aligned rows across the width of the sheet.

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23. A sheet material as claimed in claim 20 wherein the modules comprise parallel elongate hollow tubular members.

15 24. A sheet material as claimed in any of claims 20-23 wherein each module has a covering layer thereon.

25. A sheet material as claimed in claim 24 wherein the covering layer is a hard outer skin of said dilatent material.

20 26. A sheet material as claimed in claim 20 wherein the modules are spherical.

27. A sheet material as claimed in claim 20 wherein the spheres are hollow.

25 28. A sheet material as claimed in claim 20 wherein the modules are spherical and have a lightweight centre.

29. An energy absorbing sheet material comprising a thread formed from a dilatent compound which is woven or knitted into a compressible layer.

30 30. An energy absorbing sheet material as claimed in claim 29 wherein the compressible layer is contained between a pair of spaced sheets of supporting material.

31. A sheet material as claimed in claim 29 wherein the thread has a covering layer thereon.

5 32. A sheet material as claimed in claim 31 wherein the covering layer is a harder outer skin of the dilatent material.

33. A sheet material as claimed in claim 31 wherein the covering layer is a separate layer.

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34. A sheet material as claimed in any of claims 29-33 wherein the thread is hollow.

15 35. A sheet material as claimed in claim 34 wherein the thread has a fibre core.

36. A sheet material as claimed in any of claims 4-35 wherein one of said covering layers is a woven textile material containing a polyaromatic amide thread.

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37. A sheet material as claimed in claim 36 wherein the other covering layer is a textile layer.

25 38. A sheet material as claimed in any of claims 4-37 wherein the two covering layers are made of the same material.

39. An energy absorbing sheet as claimed in any preceding claim wherein the dilatent compound is a dimethyl-siloxane-hydro-terminated polymer.

30 40. An energy absorbing sheet as claimed in any preceding claim wherein the dilatent compound has Duolite spheres or lightweight filler therein.

41. An energy absorbing sheet as claimed in any preceding claim wherein the dilatant compound is Dow Corning 3179.

42. A method of manufacturing an energy absorbing sheet material  
5 comprising a resilient carrier with a dilatant material therein comprising the steps of heating the dilatant material to convert it from its normal semi-solid state into a flowable form and working the flowable material into the resilient carrier to impregnate said carrier with the dilatant material.

10 43. A method as claimed in claim 42 wherein the dilatant material is heated to 150°C.

44. A method as claimed in claim 42 or claim 43 wherein the dilatant material is fed between a pair of spaced sheets of material with voids or cavities therein  
15 and then between a pair of heated rollers which press the dilatant material into the voids in the spaced sheets of material, the energy absorbing sheet with the dilatant material therein emerging from the rollers.

45. A method as claimed in claim 42 wherein the carrier is a foam material  
20 and the flowable dilatant material is pressed into the foam into under pressure at approximately 150°C.

46. A method of manufacturing an energy absorbing sheet material comprising a resilient carrier impregnated with a dilatant material comprising the  
25 steps of reducing the viscosity of the dilatant material from its normal semi-solid state into a flowable foam using a solvent, pouring the thinned dilatant material into the carrier, and finally removing the solvent from the formed sheet of energy absorbing material.

30 47. A method as claimed in claim 46 wherein the solvent is evaporated from the sheet material by applying heat thereto.

48. A method as claimed in claim 47 or claim 6 wherein the solvent is propanol, isopropyl alcohol, methanol, dichloromomethane, trichloromethane or a mixture thereof.

5 49. A sheet material as claimed in any preceding claim, further comprising a lubricant and/or a filler.

50. A material as claimed in any of claims 2-49, wherein the dilatant is a polyborosiloxane.

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51. A material as claimed in claim 50, wherein the polyborosiloxane is a borosiloxane copolymer.

52. A material as claimed in claim 51, wherein the borosiloxane copolymer  
15 comprises a plurality of siloxane groups, each of the formula  $(\text{OSiR}_1\text{R}_2)$ , wherein  $\text{R}_1$  and  $\text{R}_2$  can be the same or different and each, independently, is a substituted or unsubstituted alkyl or aryl group.

53. A material as claimed in claim 52, wherein the alkyl group contains 1 to 6  
20 carbon atoms.

54. A material as claimed in claim 52, wherein one or both of  $\text{R}_1$  and  $\text{R}_2$  is a methyl, phenyl or 1,1,1, trifluoropropyl group.

25 55. A material as claimed in claim 52, wherein each of the siloxane groups is of the formula  $(\text{OSiMePh})$ ,  $(\text{OSiMe}_2)$ ,  $(\text{OSiPh}_2)$  or  $(\text{OSi}(\text{CH}_2\text{CH}_2\text{CF}_3)\text{Me})$ .

56. A material as claimed in claim any of claims 52-55, wherein the borosiloxane copolymer includes more than one type of siloxane group, each with a different  
30 combination of substituents  $\text{R}_1$  and  $\text{R}_2$ .

57. A material as claimed in claim any of claims 52-56, wherein the siloxane groups are in blocks or units of the formula  $(\text{OSiR}_1\text{R}_2)_n$ , wherein n is an integer greater than or equal to 4 and less than or equal to 50.

5 58. A material as claimed in claim 57, wherein the borosiloxane copolymer includes polysiloxane units of the formula:  $(\text{OSiMePh})_n$ ,  $(\text{OSiMe}_2)_n$ ,  $(\text{OSiPh}_2)_n$ ,  $(\text{OSi}(\text{CH}_2\text{CH}_2\text{CF}_3)\text{Me})_n$ ,  $[(\text{OSiMe}_2)_a(\text{OSiMePh})_b]_n$  or  $[(\text{OSiMe}_2)_a(\text{OSiPh}_2)_b]_n$ , wherein n is as defined in claim 10, a and b are integers greater than or equal to 1 and less than or equal to 49, and  $a+b=n$ .

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59. A material as claimed in claim any of claims 49-58, wherein the lubricant is a silicone oil, fatty acid, fatty acid salt or hydrocarbon grease.

60. A material as claimed in claim any of claims 49-59, wherein the filler is a  
15 solid particulate or fibrous filler.

61. A material as claimed in claim 60, wherein the filler is silica, silica and/or polymeric microspheres, a phenolic resin, a thermo-plastic material, a ceramic material, a metal or a pulp material.

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